

CLAIMS

What is claimed is:

1. A method of modulating pancreatic endocrine secretions of a patient, comprising:
 - implanting at least one system control unit in the body of a patient, wherein the at least one unit controls the delivery of at least one stimulus to at least one type of pancreatic cell affecting pancreatic endocrine secretions; and
 - applying the at least one stimulus to the at least one type of pancreatic cell in order to hyperpolarize the at least one type of pancreatic cell and thereby modulate at least one pancreatic endocrine secretion.
2. The method of Claim 1 wherein the at least one type of pancreatic cell is an alpha cell and wherein the hyperpolarization inhibits secretion of glucagon.
3. The method of Claim 1 wherein the at least one type of pancreatic cell is a delta cell and wherein the hyperpolarization inhibits secretion of somatostatin.
4. The method of Claim 1 wherein the at least one type of pancreatic cell is a beta cell and wherein the hyperpolarization inhibits secretion of insulin.
5. A method of modulating pancreatic endocrine secretions of a patient, comprising:
 - implanting at least one system control unit in the body of a patient, wherein the at least one unit controls the delivery of at least one stimulus to at least one type of pancreatic cell affecting pancreatic endocrine secretions; and
 - applying the at least one stimulus to the at least one type of pancreatic cell in order to depolarize the at least one type of pancreatic cell to thereby increase secretion of a substance that inhibits insulin secretion.

6. The method of Claim 5 wherein the at least one type of pancreatic cell is an alpha cell and wherein the depolarization increases secretion of glucagon.

7. The method of Claim 5 wherein the at least one type of pancreatic cell is a delta cell and wherein the depolarization increases secretion of somatostatin.

8. A method of modulating pancreatic endocrine secretions of a patient, comprising:

implanting at least one system control unit in the body of a patient, wherein the at least one unit controls the delivery of stimulation to at least one parasympathetic tissue innervating the pancreas; and

applying the stimulation to the at least one parasympathetic tissue in order to minimize stimulation of gastrointestinal structures and the heart while maximizing stimulation of pancreatic beta cells, whereby insulin secretion is modulated.

9. The method of Claim 8 wherein the stimulation is applied to at least one of the posterior gastric, anterior gastric, celiac, and hepatic branches of the vagus nerve.

10. The method of Claim 8 further comprising applying the stimulation to the at least one parasympathetic tissue in order to increase insulin secretion.

11. The method of Claim 10 wherein the at least one system control unit is connected to at least two electrodes, and wherein the stimulation is electrical stimulation applied via the at least two electrodes at a frequency of about 3-12 Hz.

12. The method of Claim 8 further comprising applying the stimulation to the at least one parasympathetic tissue in order to decrease insulin secretion.

13. The method of Claim 12 wherein the at least one system control unit is connected to at least two electrodes, and wherein the stimulation is electrical stimulation applied via the at least two electrodes at a frequency of greater than about 50-100 Hz.

14. The method of Claim 12 wherein the stimulation is drug stimulation and wherein at least one of a cholinceptor-blocking medication and an autonomic ganglion-blocking medication is applied to the parasympathetic tissue.

15. A method of modulating pancreatic endocrine secretions of a patient, comprising:

implanting at least one system control unit in the body of a patient, wherein the at least one unit controls the delivery of stimulation to at least one sympathetic tissue innervating the pancreas; and

applying the stimulation to the at least one sympathetic tissue in order to modulate at least one pancreatic endocrine secretion.

16. The method of Claim 15 further comprising sensing a condition and using the sensed condition to automatically determine the stimulation to apply.

17. The method of Claim 15 wherein the at least one sympathetic tissue is at least one of the ganglia of the paraspinal sympathetic trunks, celiac ganglia, aorticorenal ganglia, super mesenteric ganglion, inferior mesenteric ganglion, phrenic ganglion, left greater splanchnic nerve, left lesser splanchnic nerve, left least splanchnic nerve, right greater splanchnic nerve, right lesser splanchnic nerve, and right least splanchnic nerve.

18. The method of Claim 17 wherein the stimulation inhibits sympathetic input to the pancreas, whereby glucagon secretion is reduced.

19. The method of Claim 18 wherein the at least one system control unit is connected to at least two electrodes, and wherein the stimulation is electrical stimulation delivered via the at least two electrodes at a frequency of greater than about 50-100 Hz.

20. The method of Claim 18 wherein the stimulation is drug stimulation and wherein at least one of an adrenoceptor antagonist medication and an autonomic ganglion-blocking medication is applied to the sympathetic tissue.

21. The method of Claim 17 wherein the stimulation excites sympathetic input to the pancreas, whereby glucagon secretion is increased.

22. The method of Claim 21 wherein the at least one system control unit is connected to at least two electrodes, and wherein the stimulation is electrical stimulation delivered via the at least two electrodes at a frequency of less than about 50-100 Hz.

23. The method of Claim 21 wherein the stimulation is drug stimulation and wherein at least one of an adrenoceptor-activating medication and a sympathomimetic medication is applied to the sympathetic tissue.

24. A method of modulating pancreatic endocrine secretions of a patient, comprising:

implanting at least one system control unit in the body of a patient, wherein the at least one unit controls the delivery of drug stimulation to at least one area affecting pancreatic endocrine secretions; and

applying the drug stimulation to the at least one area in order to modulate at least one pancreatic endocrine secretion.

25. The method of Claim 24 further comprising sensing a condition and using the sensed condition to automatically determine the stimulation to apply.

26. The method of Claim 24 wherein the at least one system control unit is connected to at least one catheter, and wherein the stimulating drug is applied via the at least one catheter to at least one pancreatic islet or graft to increase insulin secretion, and wherein the drug is at least one of glucose, K⁺, Ca⁺⁺, arginine, lysine, acetylcholine, a cholinergic agonist, a beta-adrenergic agonist, an alpha-adrenergic antagonist, glucagon, glucagon-like peptide 1, gastric inhibitory peptide, secretin, cholecystokinin, and a beta-3-agonist.

27. The method of Claim 24 wherein the at least one system control unit is connected to at least one catheter, and wherein the stimulating drug is applied via the at least one catheter to at least one pancreatic islet or graft to inhibit insulin secretion, and wherein the drug is at least one of an alpha-adrenergic agonist, a cholinergic antagonist, a beta-adrenergic antagonist, somatostatin, galanin, pancreastatin, and leptin.

28. The method of Claim 24 wherein the at least one system control unit is connected to at least one catheter, and wherein the stimulating drug is applied via the at least one catheter to at least one pancreatic islet or graft to increase glucagon secretion, and wherein the drug is at least one of an alpha-adrenergic agonist, arginine, and alanine.

29. The method of Claim 24 wherein the at least one system control unit is connected to at least one catheter, and wherein the stimulating drug is applied via the at least one catheter to at least one pancreatic islet or graft to inhibit glucagon secretion, and wherein the drug is at least one of an alpha-adrenergic antagonist, glucose, insulin, and somatostatin.